



# NOVA

NEWSLETTER OF THE VANCOUVER CENTRE RASC

VOLUME 2005 ISSUE 5

SEPTEMBER/OCTOBER 2005

Dr. Carolyn Porco interview	1
Cool Camera	2
President's Message	3
Observing Sites	4
Upcoming Events	6
From the Librarian	8

## Looking Ahead

Remember, you are always welcome to attend meetings of Council, held on the first Tuesday of every month at 7:30pm in the G.M.S.O.

**Sept. 13:** UBC Astronomy grad student Jason Rowe: Extrasolar Planetary Forecasts: How's the weather on HD 209458b.

**Oct. 11:** Dr. Catherine Heymans, UBC Astronomy: Probing Dark Matter and Dark Energy with weak gravitational lensing

**Nov. 8:** Dr. Rick Greenburg, University of Arizona, is considered one of the world's experts on Europa and will speak on it.

## Next Issue Deadline

Material for the November Nova should be submitted by Monday, Oct. 31, 2005. Please send submissions to:

Gordon Farrell  
(gfarrell@shaw.ca)

## Dr. Carolyn Porco: The Biggest, Baddest Team Leader

interview by Barry Shanko

[This article, in greatly edited form, will appear in the Astronomy Now 2006 Year-book] with her to discuss the Cassini results, her interests and how she deals with being the leader on a team on which she is the solitary woman.

Cassini is the orbiting successor to Voyager's Saturn flybys. Its crystal-clear pictures of the planet, its rings and moons are scientifically valuable and are so "other worldly" striking that they should be hung in art galleries. They are causing previous ideas to be rethought and are creating new ones created as soon as they arrive on Earth.

A connecting link between both missions is Dr. Carolyn Porco. As a graduate student, she studied the spokes in the rings first seen by Voyager 1. Now with a PhD thanks to Voyager, she's involved in its successor by being Cassini's imaging team leader.

I conducted an email interview



## CASSINI AT SATURN

**Q:** How does Cassini's Saturn differ from Voyager's Saturn?

**A:** We arrived at Saturn with Cassini knowing more or less what to expect, because it wasn't our first

visit. But the instrumentation is so much better on Cassini, and we have the luxury of extended observation because we are in orbit. So we are viewing the entire system with new eyes.

Cassini is a major, exploratory expedition to a very alien and very far away place. You can barely see Saturn and its moons in a ground-based telescope. And yet, now,

continued on page 10

## Cool Camera

by Dan Collier

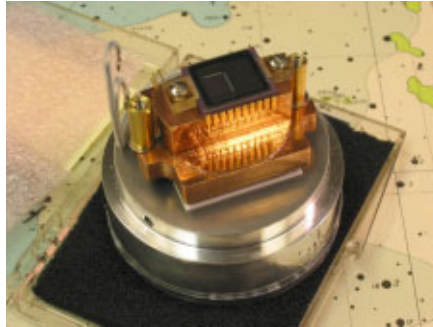
At last the Cookbook CCD camera is working “all up!” The camera was purchased as a kit by Tony Overton who donated it to our Centre before he passed away. I’ve been assembling it ever since. My final hurdle was the cooler.

The camera’s CCD chip is chilled by a thermo-electric refrigerator. The chip is mounted on a “cold finger” that I made from a piece of lab-grade copper (Rene Van Den Elzen, who donated the copper, would be amazed to see how much material I machined away). The cold finger doesn’t look like a finger at all—more like the plinth on which you’d place a miniature trophy. The finger is cooled by a heat exchanger that forms the back of the camera. The exchanger is a block of aluminum with a labyrinth of water channels machined inside.

A Peltier wafer is sandwiched between the copper and the exchanger. The Peltier utilizes the same thermo-electric effect as a thermocouple, but in reverse. Instead of generating an electric current from a temperature gradient, a Peltier gets hot on one side and cold on the other when a current is fed in. If the water can take heat away from the “hot” side quickly enough, the CCD gets very cold indeed—down to  $-20^{\circ}\text{C}$ .

Water must circulate continuously or the Peltier will be ruined. A small fountain pump will

supply the flow needed. Eric Koelemeyer gave me a Little Giant that pumps well. But it also has to *lift* the water. I’ve been using the GMSO’s 6" f/15 refractor for most of my imaging, and the camera can swing over my head. To reduce the lift, I place the 5-gallon tub that serves as reservoir on a tabletop.



Heart of the Cookbook CCD camera. The Texas Instruments TC245 CCD is on top of the machined copper block or "cold finger". At bottom is the heat exchanger that forms the camera's base. The Peltier (thermo-electric cooler) is just visible under the cold finger.

Once all the air is out of the system, flow is aided by siphoning.

Math coming! When 1 cc of water absorbs 1 thermal calorie ( $=0.001$  diet calories), it warms up  $1^{\circ}\text{C}$ . One calorie per second is 4.2 watts. The cooling system generates up to 40 watts of waste heat. Therefore 10 cc per second (4 gal/hr) will cool the camera adequately, assuming the water exits one degree warmer.

Since the pump is quiet, it is

a good idea to have a visible confirmation of flow. A visit to the planetarium junk room yielded me a Proteus flow meter. I shine my red flashlight on it periodically to make sure the paddle is turning.

The simplest water hook-up is a hose from the nearest cold water tap. This works for bench testing, but Richard Berry (the Cookbook designer) recommends a closed cycle. Water flows through a coil of copper tubing suspended inside a garbage can filled with more cold water. Chilled, the water is pumped back into the camera to complete the cycle. In this hook-up, the water in the camera loop does not have to be drained between sessions. Other users simply pump water through the camera and let it return to a reservoir. I’m doing that. A drawback is that the pump heats my water up as fast as the camera does! Vancouver tap water is famously chilly, but mine goes tepid by midnight. Stopgap measure: picnic cold packs.

Another drawback to my open-reservoir system is that the water has to be drained every night. To tell the truth, water cooling is so fundamentally inconvenient that many Cookbook users have converted to air. I don’t recommend this for beginners; the camera is too small for a decent heat sink. Moreover, even a large sink will heat up  $2^{\circ}$  to  $5^{\circ}$  for every

continued on page 6

## President's Message

Finally some clear skies, as the Rain God has been sated. For those who have been able to take advantage of the Saturday nights at Boundary Bay or Campbell Valley, there has been the opportunity to work on Messier Objects (I'm up to 59) or NGC Objects, either for pure viewing pleasure or for astrophoto collections. Bruce MacDonald had been able to arrange regular access to the latter site, known as the Little River Bowl, which should make it easier for those on the east side of the city to get out for regular viewing with some very capable observers. Craig Breckenridge has reiterated his willingness to help those interested in getting any of their observing certificates and he certainly knows his way around the night sky.

On August 11<sup>th</sup> four RASC members attended the annual Perseid meteor shower event at Aldergrove Bowl, a newly chosen site located on the east side of Aldergrove Lake Regional Park. Over the course of the evening we were joined by some 645 spectators of all ages who waited patiently for their turn at our scopes to catch close-ups of Venus and Jupiter before they disappeared over the western horizon. As night descended, the clouds covering the northeastern sky started to part and there were shouts of "Ooh" and "Ahh" as the Perseids began to arrive on stage.

continued on page 7

## 2005 Vancouver Centre Officers

### President

Ron Jerome 604-298-3292  
jerome3292@shaw.ca

### Vice-President

Pomponia Martinez 604-215-8844  
pomponia@telus.net

### Secretary

Brian Morse 604-267-6717

### Treasurer

Marc Verschuere 604-986-1485  
marcver@shaw.ca

### Librarian

William Fearon 604-939-1895  
williamfearon147@hotmail.com

### Membership

Dan Collier 604-732-6046

### CARO Committee Chair

Bob Parry 604-215-8844  
robpar@telus.net

### Director of Telescopes

Phil Morris 604-734-8708

### Public Relations

Bruce MacDonald 604-882-3820  
brumac@gmail.com

### Speakers

Barry Shanko 604-271-0615  
barryshanko@telus.net

### Nat'l Rep./Merchandising

Doug Montgomery 604-596-7058  
moondoug@home.com

### Nova Editor

Gordon Farrell 604-734-0326  
gfarrell@shaw.ca

### Nat'l Rep./Webmaster

Jason Rickerby 604-502-8158  
rickerby@dccnet.com

### LPA Committee Chair

Chris Dolman 604-707-0089  
cdolman@telus.net

### Education Cmte. Chair

Craig Breckenridge 604-437-3103  
craig.breckenridge@shaw.ca

### Trustees

Sally Baker 604-324-3309  
Karl Miller jkmiller@direct.ca

## About RASC

The Vancouver Centre, RASC meets at 7:30 PM in the auditorium of the H.R. MacMillan Space Centre at 1100 Chestnut St., Vancouver, on the second Tuesday of every month. Guests are always welcome. In addition, the Centre has an observing site where star parties are regularly scheduled.

Membership is currently \$58.00 per year (\$34.25 for persons under 21 years of age) and can be obtained by writing to the Treasurer at the address below. Annual membership includes the invaluable Observer's Handbook, six issues of the RASC Journal, and, of course, access to all of the club events and projects.

For more information regarding the Centre and its activities, please contact our P.R. Director.

NOVA, the newsletter of the Vancouver Centre, RASC, is published on odd numbered months. Opinions expressed herein are not necessarily those of the Vancouver Centre.

Material on any aspect of astronomy should be e-mailed to the editor or mailed to the address on page 5.

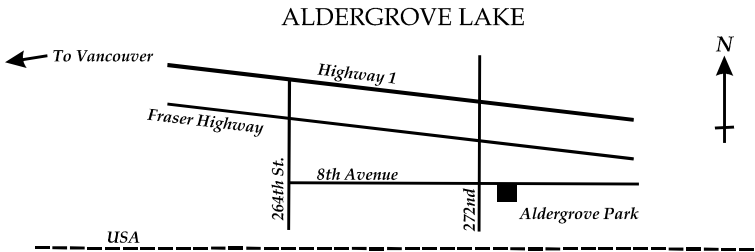
## Advertising

Nova encourages free use of its classified ads for members with items for sale or swap. Notify the editor if you wish your ad to run in more than one issue.

## Commerical Rates

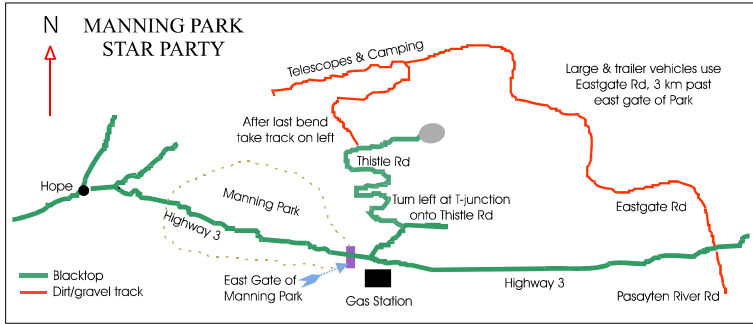
1/4 Page: \$15.00 per issue  
1/2 Page: \$25.00 per issue  
Full Page: \$40.00 per issue  
Rates are for camera-ready, or electronic files. Payment, by cheque, must accompany ad material. Make cheque payable to: RASC Vancouver Centre.

# Observing Sites

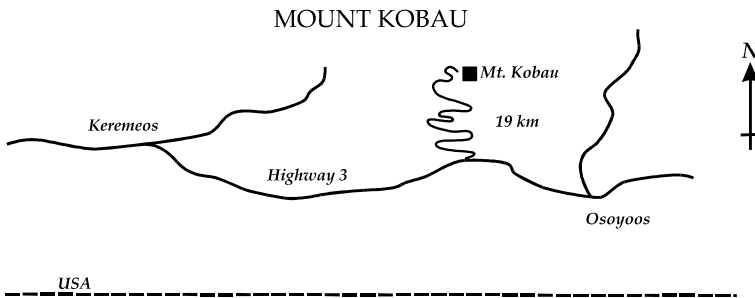


Dale McNabb Observatory in Aldergrove Lake Park (RASC Vancouver Centre's regular viewing site)

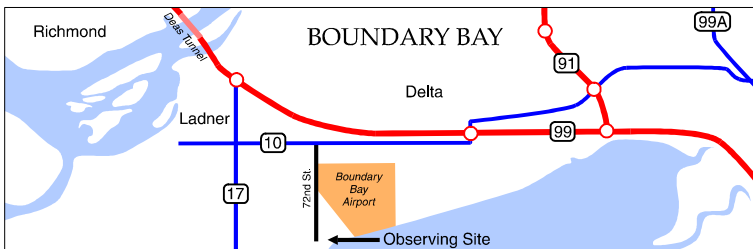
Contact Mike Penndelton (604-888-1505) or Howard Morgan (604-856-9186)



Site of the annual star party organized by the RASC Vancouver Centre



Site of the annual Mt. Kobau Star Party organized by the Mount Kobau Astronomical Society



Site of the regular Saturday night star party. On the dike at the foot of 72nd St.

## FOR SALE

The club has two telescopes for sale. Contact a council member after the meeting if interested:

60 mm f/15 refractor with a German equatorial wood tripod mount. Asking \$100.00

4.5" Tasco reflector with a manual german equatorial mount and tripod. Red & Black \$125.00



## RASC MERCHANDISE

Available for purchase after meetings:

Calendars	\$14.00
Golf Shirts	\$30.00
Sweat Shirts	\$30.00
Centenary Mugs	\$ 7.00
Beginners' Guides	\$15.00
Observers' Guides	\$20.00
Cloth Crests	\$11.00
Lapel Pins	\$ 6.00
L.E.D. Flashlights	\$22.00

## ASTROCOMPUTING

**SpaceBase™** (604-473-9358,59). Affiliated since 1992 with RASC Vancouver, our link to RASC Net, RASC Members only chat area. Future data distribution hub for CARO Project. Features include latest HST images, current world space news and astronomy programs.

## LIBRARY

The centre has a large library of books, magazines and old Nova's for your enjoyment at the GSO. Please take advantage of this club service and visit often to check out the new purchases. Suggestions for future library acquisitions are appreciated.

### RASC-VC on the Internet

<http://www.pcis.com/rascvan/> or  
<http://www.rasc.ca/vancouver>

## H.R. MACMILLAN SPACE CENTRE

The Pacific Space Centre Society is a non-profit organization which operates the H.R. MacMillan Space Centre and Gordon M. Southam Observatory. Annual Membership (\$30 Individual, \$80 Family) includes a newsletter, Discounts on Space Camps, special programs and lectures, Vancouver Museum Discounts, and free admission to the Space Centre. Admission to the Space Centre includes: Astronomy shows, Motion Simulator rides, multimedia shows in GroundStation Canada, and access to the Cosmic Courtyard Exhibit Gallery. For Membership information, call Mahi Jordao at 604-738-7827, local 237 for information. You can also reach them on the Internet at <http://www.hrmacmillanspacecentre.com/>

## MEMBERSHIP HAS ITS PRIVILEGES!

New members, did you know? The Vancouver Centre has 8 telescopes available for loan free of charge! We have telescopes ranging from 60mm to 10" diameter. For more information see Phil Morris, Director of Telescopes in the meeting room of the GSO *after* the members meeting. All telescopes are to be picked up and returned at the GSO. The loaner period is for one month, to be returned after the next meeting. Telescopes are not allowed to circulate outside of these meetings. You can now reserve 2 different telescopes per year and use what is left at the end of the meeting anytime. Phil can be reached at 604-734-8708.

Your greatest opportunity as a member of the R.A.S.C. is to take advantage of the company of other enthusiasts to increase your knowledge, enjoyment and skill in astronomy.

The best thing you can do to gain the most from your membership is to get active! Take in the club meetings; engage other members with questions; come out to observing sessions (also known as "star parties"), and, by all means, volunteer to take part in our many public events.

Observing takes place at Boundary Bay on the dike at the south end of 72nd St. in Delta (see map on p. 4). We are there most clear Thursday/Friday nights. Contact Jason Rickerby at 604-502-8158.

**RASC**  
**1100 Chestnut Street**  
**Vancouver, B.C.**  
**V6J 3J9**  
**604-738-2855**

## Upcoming Events

---

### October

8 or 9 – Sidewalk Astronomy  
29 – Mars Watch begins

### November

5 – Mars Watch ends

### December

13 – AGM

---

continued from page 2

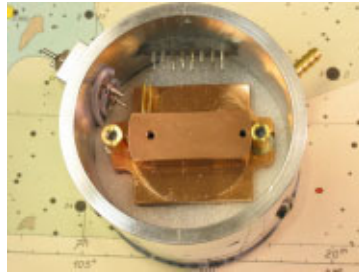
watt of heat committed to it, and we're talking 40 watts here. A fan helps, but you need a powerful one. The situation is not unlike cooling a hot microprocessor—similar size, heat, and capital risk. However, the micro runs nicely at 80°C. You need to keep your Peltier near or below room temperature. And you don't need the vibration.

What does make air practical is a second, smaller Peltier wafer between the CCD and cold finger. Stacked in this way, the Peltiers work in cascade like a 2-stage space rocket. High-end CCD cameras have this feature. An \$8,000 camera from SBIG has *both* a fan and water cooling pipes. For most work, the fan suffices; adding the water boosts you into the -25°C regime.

Even with a single stage, the Cookbook can get that cold. The cooling system is as overpowered as my wife's '71 Pontiac. (More displacement than a gallon can of paint, and the tailpipe smelled as bad. She bought it when ethyl was 55 cents a gallon. We sold it just before Iraq. I believe it could beat any Honda to the far crosswalk.)

Why cold? A CCD utilizes the photoelectric effect in silicon. When a photon lands in one of the pixels, or *photosites*, it jiggles the atoms in it. The vibration shakes

loose one or two electrons which are then free to move around. However, an electric field around the photosite corrals the liberated electrons. They remain in storage



The partially assembled camera, with cold finger installed. Note the offset to centre the CCD's active area. Power for the Peltier enters via feedthrough caps at upper left. The leads of the temperature sensor stick up from the cold finger just right of the feedthroughs. The pins of the CCD (not shown) were wired to the 16-pin connector during final assembly. The foam in the bottom prevents heat from re-entering the chamber from the exchanger base.

until the computer "reads out" the photosite. However, the atoms are shaking even without any photons coming in. The camera's warmth is enough to excite them, and electrons duly come loose. There is no way to separate these thermal

electrons from the ones that are forming your image. The result is an image contaminated by heat. A little cooling has a dramatic effect. The atoms settle right down, and fewer thermals are generated.

Many users "stack" multiple images made of the same object. I have to do this to get sharp star images because our clock drive has periodic error. Not a lot. The polar gear was made by Jim Egger in Alaska, a craftsman. But it's enough to cause star trails in exposures longer than a minute. Shorter exposures also mean fewer thermal electrons. So the question arises: do you need cooling at all? Yes. Whether you take long exposures or "stack" short ones, the thermals add up in similar numbers.

You don't want them because they're *noise*. Not noisy bang-bang, but in the sense of salt-and-pepper in your images.

The noise is Poisson statistics. The *average* number of thermal electrons is unchanged from exposure to exposure, all things being equal. But the number varies randomly. Think of pouring BB shot into a tin can. The dropping BBs make a rattling, hissing sound. The sound is music to engineers who make a living ridding it from radio sets [*Ahem*—author raps his dinky ring on his

continued on page 7

continued from page 3

It was a decent showing, considering it was not the peak night, and it certainly underscores the interest the general public has in the night sky. It also reminded me of how much I have yet to learn, based on the number of questions I felt unqualified to answer in any detail. Back to the books this winter.

The Mt. Kobau Star Party was another unqualified success. Those who attended said that the seeing conditions were the best that any of them could remember. We are looking forward to viewing the efforts of some of our dedicated astrophotographers at our Member's Night in December.

We continue to build our support group for the Chris Graham Robotic Telescope Project. The first organizational meeting was held in late August and we were delighted to have encountered a broad base of interest. It looks like the scope will be installed mid-November 2005 and that it could be operational from Vancouver mid-December 2005.

For the past three years your centre has donated a stargazing evening to a Rotary Club sponsored fund-raiser. This year's proceeds will help build a dormitory for the 80 boys at the El Hogar Technical Institute in Honduras, the site of the club's

international project. According to our contact, these are boys currently sleeping under the stars! It has been a popular auction item and it is one more way we reach out to the community.

On a personal note, my daughter was married in Phoenix on September 4<sup>th</sup>. The evening after the wedding a group of us were standing on the balcony of our hotel watching a beautiful desert sunset. Embedded in the bright band of colour that stretched across the sky were two jewels—Venus and Jupiter. It was a wonderful finale to an already memorable day.

— Ron Jerome ★

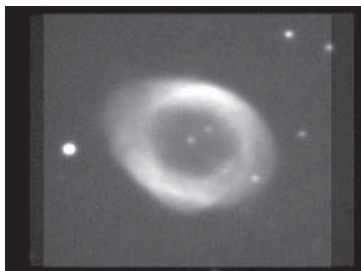
continued from page 6

desk]. We call it *shot noise*. Bring the CCD below  $-10^{\circ}\text{C}$ , and you can remove most of the shot noise from the image by subtracting a *dark map* (a dark map is an exposure made under identical conditions but with the CCD

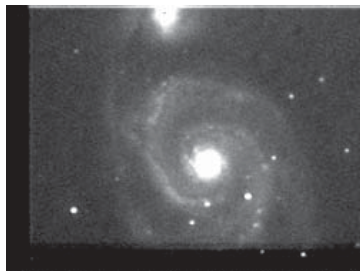
covered).

I don't know exactly how cold my CCD is. I know it's cold because thermal electrons largely disappear from my images when the Peltier comes on. But I'll find out, soon enough. I glued a sensor on the copper bit when I

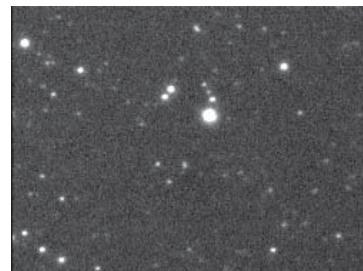
assembled the camera. The sensor is a temperature-sensitive current source. It delivers one microamp for every degree above absolute zero. Add a precision 1,000 ohm resistor and a digital voltmeter, and I'll have Kelvins on tap. The results? Next NOVA issue! ★



M57. Prime focus, GMSO Cassegrain (20" f/16). Nine unguided 30-sec exposures manually stacked using CCDSoft.



M51 and SN2005cs, 0600 UTC 29 July 2005. Prime focus, GMSO refractor (6" f/15). Twenty-eight unguided 60-sec exposures combined with Registax. The supernova (discovered in June by a German amateur) is the "star" under M51's nucleus.



Pluto, 0710 UTC 15 July 2005. Prime focus, 6" refractor. Unguided 60-sec exposure. Pluto is the lowest "star" of the triangle below at centre.

## From the Librarian

---

by William C. Fearon

This issue will contain two book reports on books in the library for the beginner in astronomy and for those looking for a challenge that can be taken up from even a brightly lit city like Vancouver.

First I will report on *The Isabel Williamson Lunar Observing Program* booklet from National Office. This booklet will lead the astronomer through a check list of 135 objects on the Moon which, when completed and submitted to National, will result in the astronomer receiving a Lunar Observing Certificate named for Ms. Isabel Williamson. Though a lot of these objects can be seen without the aid of a telescope, the list can be completed with a telescope of no more than 100mm (4 inches) in size.

The Booklet contains a short primer on Lunar Geology (what are those surface features?) and Lunar Geographical Place names. Also some observing tips are included in this section.

The next section deals with introducing the Moon. It leads the astronomer through Phases of the Moon and Orbital Motion to things such as Ray System extent and Libration.

Then comes the main section, the Observing List, which provides the Lunar Longitude and Latitude of the object, origin, type of feature and where to find the chart for this feature in Anton Rukl's

Atlas of the Moon (which is in the library, but very popular and may not be available). This is the only complaint that I have with booklet as you need to have some form of Lunar atlas to begin with before starting this observing program. The Observing List has objects such as Mare Crisium to craters like Moltke (#45) at 6.5 km with the Rimae Hypatia (a Lunar Rill or valley) to very small features such as the crater Linne (#57) and the Volcanic Domes around Montes Caucasus (#60).

The booklet finishes off with an additional 10 objects to challenge an astronomer. These items are on the edge of the Moon and require waiting for Libration to bring them into view to be seen.

I would gauge this as something that a beginner who is looking for something to sink her/his teeth into after becoming familiar with the basics of astronomy and wants to do some astronomy instead of just looking.

Ms. Isabel Williamson was a long-time fixture at the RASC Montreal Centre. She would help beginners find their way around, and to start them off she decided (back in the 1940s) that to sharpen observing skills new astronomers should study the Moon. One of these she helped was a teenaged boy named David Levy (yes, the David Levy of Asteroid and Comet fame). So to honour her after she passed away a few years back, the RASC National Council decided to name its new Lunar Observing

Certificate and Program after her for her contributions.

Next up is one of my favourite books, *The Backyard Astronomer's Guide*. Authored by Terence Dickinson and Alan Dyer (Terence Dickinson is the editor of Sky News astronomy magazine and lives in Ontario, and Alan Dyer is a member of Calgary Centre and works at the Calgary Science Centre).

The book is divided into 3 sections and a total of 15 chapters. Starting with optics for the Beginner, such as Binoculars, in chapter 2 through Telescopes for recreational astronomy in chapter 3 to Essential Accessories, such as Eyepieces, in chapter 4. Then chapter 5 gets into the other accessories such as Mounts and maintenance information such as collimation. Chapter 6 finishes the first section with information on using your new telescope, such as how a telescope moves, lining up the finder and first-light do's and don'ts. The chapter ends with the answers to the Top 10 questions by beginners that the authors have received.

In Part 2 the beginner is introduced to the night sky. Chapter 7 covers Phenomena of the Sky in the Day, at Sunset and the Darkening Sky. Visible-to-the-eye things such as Conjunctions, Meteors and Auroras are also covered. The chapter ends on how to record your observations. Chapter 8 covers your observing

continued on page 9



continued from page 8

site (what to look for) and things like Light Pollution, limiting magnitude and the magnitude scale. Chapter 9 leads the astronomer into observing the Sun, Moon and Comets (clear instructions on how to SAFELY observe the Sun are included). Next comes chapter 10 on how to go about observing the Planets (and where to find them in the sky and when). Then in chapter 11, the astronomer is taught how to find her/his way around the sky at night. Introducing such things as the Ecliptic, Star-Hopping, where to find the North Star and lastly Star Atlases. This is followed by chapter 12 which introduces the

astronomer to the Deep-Sky and the objects therein such as Galaxies and Clusters, as well as introducing the various catalogues of objects such as the Messier Catalog, The NGC and IC and others.

In Part 3, the idea of Astro-Imaging is introduced. First, in chapter 13, Astrophotography with a stand-alone camera is introduced. The various objects that can be photographed in the sky without a telescope—such as Aurora, Constellations and Lunar Eclipses to name a few—are discussed (This book was published in 1992 and does not cover Digital Systems. An updated version was published in 2002, but

the library does not yet own a copy of that version—yet!). In chapter 14, the techniques for using your camera at the telescope are introduced and chapter 15 covers things such as Gremlins and Advanced Techniques in Astrophotography.

I (your librarian) own both versions of this book and I urge you—if you do not yet have it, and are serious about astronomy—then this book should be in your own library. I found mine at Chapters, but if you need to wait, come and borrow one of the 3 copies of the 1992 edition that the centre library has.

That's all for now. ★

---

## New from the Library

by William C. Fearon

New into the library are two books for beginners. The first is a book from England called the *Pocket Guide to Stars & Planets* by Ian Morison and Margaret Penston. This is an elementary-level introduction to astronomy for those who do not consider it necessary to know everything about astronomy to enjoy it. The book has good constellation charts and a top-50 object list. The only drawbacks are that for some objects you will need a real telescope and a few others are in the Southern Hemisphere (so how

do you see them from England?). But, as London, England and Vancouver share the same Latitude (more or less) the book can be used from here as well.

The second book is a good book. The name is *Atlas of the Night Sky* by Storm Dunlop. In its pages you will find Star Charts (by Wil Tirion) and a Lunar Atlas (by Anton Rukl). Additionally, a constellation-by-constellation guide to objects of note in each constellation is provided. Then it moves into observing the Moon with some very fine charts of the Moon (these can be used with the

Isabel Williamson Lunar Observing Program). However, it falls down when it comes to the rest of the Solar System. Good finder charts that can be used up to 2009 are included, but only Mars, Jupiter and Saturn have anything more than a cursory mention of details and observing methods (especially as the Planets section is condensed into 17 pages). Unless you are seriously interested in planetary viewing, this is a book I highly recommend checking out of the Centre library.

I hope to see you at the library at the next meeting! ★

continued from page 1

everyday, it's some new, often bewildering sight. The exotic and spectacular have become commonplace. As I've said many times, it's exploration at its finest.

**Q:** How do Cassini's images compare to Voyager's when of similar resolution?

**A:** The Cassini cameras have greater fidelity in reproducing different levels of reflected light, and so the images are clearer than Voyager's.

**Q:** What has been the most significant finding(s) so far?

**A:** Where do I start! How about:

- Phenomena throughout the rings that we didn't know existed.

- Unique structures on the dark, previously uncharted side of Iapetus and no evidence whatsoever of volcanic resurfacing and flooding (as some had thought).

- The dizzyingly contorted surface of Enceladus, accompanied by heat and water vapor preferentially coming out of fractures in the South polar region, that tell of the small moon's very complex geological and thermal history

- Finally seeing the surface of Titan with our cameras and with the cameras on the Huygens' probe. That one Huygens' image of the dendritic drainage patterns, on the shore of a large, dark low-lying region, that speaks of flowing liquid on the surface... the sight of that was like being hit over the head with a frying pan. I was stunned speechless.

**Q:** What are you looking forward to?

**A:** I'm greatly looking forward to

getting into those orbits from which our view of the planet and rings will be very different than we have seen for the last year. In the middle of the tour, we will be looking at Saturn closer to full-phase, and so more of the planet and the rings will be illuminated. We'll be making atmospheric movies during those orbits that will be wonderful to watch.

And then towards the end of the tour, we will crank the orbit of the spacecraft up to high latitude, and look down on the whole system and see Saturn literally like no one has ever seen Saturn before... with the rings laid out, like a bull's eye pattern, below us. I suspect that will be breathtaking. This is one trip on which I'm glad we remembered to take along a camera!

**Q:** You made your scientific mark by studying the rings' "spokes." Have you discovered anything new about them?

**A:** Not only have we not yet discovered anything new about the spokes, we haven't even seen them yet! We now suspect that they are probably still being generated but we just can't see them in the present illumination geometry. Later on, when the sun gets lower on the rings (as seen from Saturn), they should be visible again.

It's funny, my work on spokes seems to be what I'm most known for in the public's eye, but I wouldn't say that's where I made my scientific mark. I think in the planetary world I'm best known for my work in studying eccentric rings and ring arcs and their dynamical relations to moons.

**Q:** What is your favourite Saturnian object so far?

**A:** I think the images that captivate me the most at the moment are those of Enceladus. They, like all others, are so crystal clear, and I enjoy imagining that I'm bodily flying over the bewildering patterns of folds and criss-crossing fractures, and marveling at all those torturous twists and turns of a once-fluidized surface. I can easily get lost in all of that.

But of course, in the end, I come back to Saturn with its rings which dazzle from every angle. Truly other worldly.

**Q:** What was your first reaction to Huygens' Titan images?

**A:** As I said above, I felt like I had been hit over the head with a frying pan, left walking around in a daze. I couldn't believe I had just witnessed one of the most momentous occasions in human history, and was privileged enough to be alive *now* and to see what we saw. I was in a stupor for several hours afterward.

**Q:** Now that you've had a chance to digest them, have you seen anything new that changed your initial impression?

**A:** No, they've only become more fascinating because we understand them better. And our initial impressions were right.

**Q:** You first got interested in astronomy by seeing Saturn through a telescope. Your doctorate came via your work on the rings. With Cassini, do you feel like you've come "home?"

**A:** You bet! That's exactly what it feels like. I remember seeing our

continued on page 11

continued from page 10

first Cassini images of Jupiter, which to me is the gateway to the outer solar system, and getting teary-eyed... not only because they were breathtakingly beautiful, but because I felt like I was, at long last, making my way home. Jupiter was Voyager's first flyby. So, getting to Jupiter with Cassini was the beginning of the final stretch.

It thrilled me with anticipation. And then to make our way, over the following 3.5 years, to Saturn itself was like arriving back in the land of my youth. I was a graduate student when Voyager got to Saturn and made my first scientific discoveries there. I feel like I grew up there. After Voyager was over, I very much wanted to go back. I'm at peace knowing that I did.

It all reminds me of the Neil Young song:

*"There is a town in North Ontario  
With dreams, comfort and memory  
to spare  
And in my mind, I still need a place  
to go  
All my changes were there"*

**Q:** When you see Saturn in the night sky or through a telescope now, what goes through your mind?

**A:** How so very far away it is, how truly bold, daring, imaginative, hopeful, and far-reaching we are to have attempted such an ambitious adventure, and how unknown it still would be had we not succeeded.

I think: We are now skipping around Saturn and its rings and

moons like we belong there. We have landed a device of our making on a moon of Saturn, ten times farther away than the Earth is from the Sun, and 7 times farther than we've ever landed anything else before. We have firmly arrived in the outer solar system, and because of that, the solar system has become a much smaller place. And "WE" did it.

We were the first. No generation of humans living on this Earth before us could have said that. You don't get much luckier than that.

**Q:** What's your biggest surprise so far? Biggest disappointment?

**A:** The biggest surprise was how clear and precise our images are. I revel in them every day.

Surely, my biggest disappointment has been the political backdrop to this dramatic adventure. It has been far more politically embattled than I ever imagined it would be. Just as one example, as I write this, Cassini scientists are having their contracts audited by the Jet Propulsion Laboratory. "Why?" I say. We give everything we have to make the mission a success, and this is what we get in return... to be treated like we're doing something illegal and wrong? Add to that the fact that we have been woefully underfunded from the start, and that it's been very hard to get even the minimum amount of funding to do the job, and you see how disappointing and frustrating it can be.

I never dreamed such a magnificent and noble enterprise would have to fight so hard to

continue to function. There's something seriously wrong with that picture. We need to do something about the state of American science in general, and the place to begin is in recognizing the significance of what scientists do for the future of our life on this planet. In the long run, nothing will affect the kind of lives future human generations will be leading than the work being done by scientists today. It is foolishly myopic to short-change the scientific enterprise. Yet that's where we are. It's cause for tremendous alarm.

**Q:** If you had to do it all over again, what would you do differently?

**A:** Not much. Things have gone spectacularly well, despite the serious challenges, and that's because I've given this mission and experiment absolutely everything I had. And I would do that again. I know I would.

But I suppose, if I had to do it again, I wouldn't doubt myself so much. I realize now, looking back, that I always had the "right stuff" for this job. I just didn't know that at first. And I am immensely proud of how the imaging experiment has turned out. It would be nice to have more funding to make the presentation of the images even more spectacular.

**Q:** Being in your position often means having to make tough choices. Can you name some and how you tried to patch up things after?

**A:** No, I can't think of any tough decisions that I made that went

continued on page 12

continued from page 11

badly... at least not big ones. I will say that being the principal investigator for the imaging team, and leading the biggest, most visible experiment on the Flagship of American missions—or as I like to say, “the biggest, baddest experiment on the biggest, baddest mission”—is very much being in the hot seat... ALL the time.

The images from any spaceflight mission generate most of the publicity and all the emotion. So, more often than I care to say, I have found myself at the nexus of competing interests of some very large institutions, like JPL, NASA, foreign space agencies, etc. So, I have had battles and issues that the other principal investigators on Cassini don't have, and they haven't been pleasant.

**Q:** Has Cassini really done a billion dollars worth of science?

**A:** Without equivocation, without doubt, a resounding yes to this question. And we're not finished yet.

**Q:** If money were no object, what kind of follow-up mission(s) would you want to see done?

**A:** I'd want a spacecraft that could hover, very closely, over the rings of Saturn and orbit with them, watching the individual ring particles interacting with each other, and studying their interactions. This would be like a classic Physics 101 air table experiment.

It would be tremendously useful in understanding what small icy grains and cobbles do when colliding with and rolling over each

other as they orbit a planet. And that in turn would help us understand not only how a disk of material, like Saturn's rings, changes and evolves with time, but also how such ice grains and cobbles first coalesced together to grow into larger bodies which eventually formed the planets. This is one mighty cardinal question in the study of planet formation, and such a mission could kick-start a new era in such studies.

And of course, I'd like to see a suite of missions to Saturn's moons: one or two to explore Titan, either with balloon-borne instruments or airplanes, and perhaps one to study Enceladus.

Actually, if money were no object, I'd like to see such in-depth exploration of all the outer planets. A Cassini-capable orbiter around Jupiter, Saturn, Uranus and Neptune, with bandwidth large enough to return streaming video from these marvelous worlds... Now that's something to look forward to.

### **I AM WOMAN**

In these “modern” times, it's sad the subject has to be broached, but woman in science are still few and far between. A female leading a team on a major science mission is rarer still. I asked Porco what being a woman in a man's world is like.

**Q:** From your point of view, how has the position of women in science changed since you started?

**A:** There are certainly a lot more of us than when I got started 30 years ago in graduate school. So, we're not so much of a novelty any

more. But the core issues are still there.

We have won the strategic battles—i.e., there are laws in place to guard against gender-bias—but the tactical battles remain. Women are more easily ignored. Many of us do not do so well in hand-to-hand combat, and a lot of scientific discourse takes place in that style.

The scientific method is based on criticism; it is essential to the process. Women are inculcated to be sweet and unoffensive; men often thrive on being offensive. The more offensive, the more manly. I can criticize someone's work bluntly and it comes off harshly and takes people by surprise, because I'm not “supposed” to behave that way. A male acting the very same way is a “stud” to be admired. Until these cultural expectations change, women will always have a greater struggle.

**Q:** Who has inspired/mentored you? Could you have gone as far as you have without them?

**A:** I had very encouraging professors in college, and frankly if they had discouraged me, I'd be nowhere now. So their mentorship and tutelage and encouragement were very important for a young girl making her way in a world of men. I also had a mother who, while expecting me to get married and have kids, also told me (and all her children) to “reach for the Sun, the moon and the stars.” I don't think she thought any of us would take it literally!

I also had the tremendous good fortune to meet Carl Sagan when I was in college and then

continued on page 13

continued from page 12

come to know him better while a graduate student, and then again as members of the Voyager imaging team. He went out of his way to be encouraging towards me. I have so many stories! It was so unexpected. He was just that way. I know he was encouraging to a lot of young scientists, especially women. It meant a great deal to me.

**Q:** I have a 9 year old niece now becoming interested in astronomy. If you knew then what you know now, what advice would you give her and/or her parents?

**A:** Make sure she knows that 9 year old girls rock! It's around that age that girls come into their own. They are so wonderful at that age. Yet, in many cases, after 9 or 10, they become so distracted with boys and needing to conform, they come to doubt their own inner selves, and question their own judgment. Anything that could be done to stop this would be a life saver. Explicitly reassure her that no matter what the 'world' is screaming at her to do or become or look like, she is as strong, capable and intelligent as any boy and can do whatever they do, including handle abstract concepts like math.

**Q:** What were you like in high school: one of the honour roll types; part of the "in crowd," or just buried in the faceless masses?

**A:** I always had a foot in both camps. I was an honor roll type, but I was also a baton twirler and did that sort of thing. Later on, in college, I became a drum majorette for a Buddhist marching band—no

kidding!—and led a fife and drum core in the St. Patrick's Day parade and then again in Japan. That was in the early 70s. Those were the days.

**Q:** What drove you to become imaging team leader? What do you think you can do that others couldn't?

**A:** One of my best traits is that I don't let very many things stop me from doing what I really want to do. Having been on the Voyager imaging team, I just knew I could be the leader. I knew what needed to be done at Saturn scientifically, and what the big remaining questions were, and I just went for it. The idea of being the "captain" standing on the bridge, looking out the window... that was a mental image I had that hasn't gone away. It was very seductive.

I don't think there are many people who would have devoted themselves to this job the way that I have. The job required inordinately long spans of time—I'm talking years—of 7-day work-weeks, and intense concentration and guardianship to make it all come together. Not many people can summon that kind of focus or energy.

**Q:** Does a woman bring a different style to managing?

**A:** You have to ask my team members this! I know that I don't try to play mom with anyone. I'm not the nurturing type. I'm pretty no-nonsense and straightforward: it's just simpler that way. And I think that anyone who has ever worked with me would say that I am a tough, demanding task-master. The job we set out to do

and the conditions under which we had to do it required nothing less. But I think others would also say: I don't demand anything of others that I don't demand of myself. I'm even tougher, more demanding of myself.

**Q:** You are the only woman on the science team. Do you ever feel isolated or just plain different from the rest?

**A:** Yes. But being the leader, an individual who is naturally playing a very different role than the rest, I find it hard to distinguish the two possible sources of this feeling of "differentness": being the leader, or being the only woman. I grew up with 4 brothers: I had no sisters. So, I am very comfortable being with and working around males. But there are gender issues involved here, no doubt. No one... not even women... in this business has an easy time with a woman in a leadership position. So, do I feel that I've had significantly greater challenges than my male counterparts? You bet I do.

Also, until a short time ago, I was the only woman principal investigator on the entire mission, having to argue for precious spacecraft resources up against 11 other (male) individuals also arguing for resources. This arena is where the greatest challenges have been, and I'll simply say about this that the old boys club is alive and well and thriving... but so far, I'm still standing.

If and when I find myself particularly challenged by gender-related issues, I always think of what Colin Powell had to say when

continued on page 14

continued from page 13

asked what it was like to be a black man in a white man's world. He said: "You may have forced me to play on this little corner of the playing field. But that's all right by me, because I'm gonna play my game, I'm gonna play it well, and I'm gonna beat you anyway." That's exactly my attitude.

**Q:** The very first time there was a meeting of the imaging team, did you feel any added pressure to perform?

**A:** I remember that meeting and I felt very, very strange. Not only because I was the only woman, but because several other individuals who had applied to be the team leader were on my team, and they were all male and all older than me, and I could sense the resentment. This was a *highly* coveted position and I won. That set the stage for some 'issues' that linger 'til this day. But these have become part of the political milieu that I have come to learn to operate within. There really isn't much a person in my position can do about it except do the best that you can, which I do... always.

## **'SCUSE ME WHILE I KISS THE SKY**

Those who know Porco say she has an inquiring mind, is a terrific communicator, has a keen sense of humor and is a lover of classic rock. When the magazine *Nature* published the team's Titan paper, the magazine called the cover picture "Purple Haze" to describe the upper layers of Titan's atmosphere and as an ode to Jimi Hendrix. According to one of the team members, Carolyn was

thrilled.

**Q:** You've said religious considerations and wanting to find your place in the universe led you to astronomy. What were they, and have you found your place?

**A:** It was the big questions of wonder: What am I? What am I doing here... alive, now, and on this planet? What is out there? What's the purpose of it all?

I have indeed found my place, "our" place, and while it is shockingly small and insignificant, it is also tremendously comforting. The very fact that we are all part of something so much bigger and grander than anything immediately around us... and the fact that, as small as we are, we can *know* our circumstance... is itself a source of wonder, empowerment and deep spiritual fulfillment.

I don't need to believe in God. I don't need the fantasies promulgated by formal religion to comfort me in the face of the vastness that engulfs us. Knowing that in me, and through me, the principles governing everything in the Universe exist and flow is all I need. That's my religion. As George Harrison put it:

*"When you've seen beyond yourself  
Then you will find peace of mind  
is waiting there.*

*And the time will come when you'll  
see we're all one  
And life flows on within you and  
without you."*

**Q:** You're known as a ring

specialist so why are you involved in the pluto mission?

**A:** I'm a ring specialist, but I am scientifically interested in many things, including the makeup of the outer solar system beyond the giant planets. I am also an imaging scientist, and my role on Pluto is as an expert in imaging science.

But really, I'm involved in the Pluto mission because I firmly believe we need to complete the initial reconnaissance of our solar system that was begun nearly 50 years ago. We can't say we've visited and sampled the great diversity the solar system offers until we reconnoiter Pluto, which is a member of the Kuiper Belt.

I was a member of the Voyager mission, the first to really unveil the bodies in the outer solar system. And now, I want to be among those who first see the last outpost. I want that closure.

**Q:** If you hadn't become a scientist, what do you think you would have ended up doing?

**A:** A musician. I had more, I believe, innate talents in music than in the sciences, which is to say: music came naturally and easily, science I had to work at. I also got the only A+ I ever got in college in music theory.

**Q:** When you aren't busy being a scientist, how do you spend your time?

**A:** If you had asked me this a decade ago, before Cassini had gotten me in a vise grip, I would have said: hiking, bicycling, playing guitar and singing.

**Q:** Your comments on the web site is called "Captain's Log." Do

continued on page 15

continued from page 14

you secretly want to be Capt. Kirk?

**A:** I AM Captain Kirk... just don't tell anyone ;-)

**Q:** Your writing and other activities indicate you have an artistic side. If true, care to give some examples?

**A:** Yes, absolutely. My mother was very artistic. She was fantastic at sketching. She used to sing, very loudly! The whole neighborhood could hear her. She had a booming, very male-like voice, despite the fact that she was just 5'2" tall. She even used to write songs... not with musical notation, but in the way that untrained musicians do today. So, I got the creative/artistic tendencies from her.

I used to compose songs on my little Eminee organ when I was a kid, and wrote plays that I got the kids in my neighborhood to act in. I even choreographed a tap dance once that I got my best friend to do with me for a talent contest. (We lost, so that ended my dancing career.) And I used to sing and play guitar, though unfortunately I can't do much of that any longer.

**Q:** If I looked into your iPod (assuming you had one) what songs or groups would I find?

**A:** Of course, I'd have the Beatles... the best, most influential, creative, imaginative musical group that ever lived. Damn, was I lucky to be alive and young during the '60s. The planet lost one of its brightest stars when John Lennon was murdered.

I'd have U2—Bono reminds me a lot of Lennon. I'd have Bonnie Raitt, Paul Simon, African

music, Hawaiian music, Irish music, and a lot of oldies.

**Q:** The best space song ever is \_\_\_\_\_?

**A:** "Thus Spoke Zarathustra" because it was the theme song to the greatest science fiction movie ever made, *2001*, and it captures for me the 'big' and the wonder of space.

**Q:** What's the story behind the "Abbey Road" picture? [[http://ciclops.org/team/iss\\_team.php](http://ciclops.org/team/iss_team.php)]

**A:** It was something I wanted to do for a long time... kind of a fantasy... to have the Imaging team photographed crossing Abbey Road, in costume. I couldn't convince all of them to do it, but the most spirited ones did. It was a very funny undertaking. But it worked, although some of my team members aren't very coordinated so we couldn't get the legs all going correctly. But if you look clearly, the Paul's have no shoes and are carrying cigarettes. We paid attention to details.

I tell young people, who might one day want to be in my position... of leading a team of scientists in a major scientific investigation... that you know you're doing a good job leading your team, that your powers of persuasion have become very well-developed, if you can convince 6 grown men to follow you, in costume, across the most famous cross-walk in the world!

**Q:** Most scientists don't seem to like doing PR, yet you seem to enjoy it. Why?

**A:** I didn't start out knowing I could do it or would like to do it. But ever since I first started talking to the press about science, which

was during the Voyager Uranus flyby, I was told that I had a talent for doing the 'Carl Sagan' thing. I've had interviewers tell me I should try to host a science documentary, or write, or do things of this nature. When you get feedback like that, you take notice. So, I have just become more conscious of doing a good job when I write or speak to the public. And it's wonderful when you hit the mark.

I've gotten a lot of positive feedback from my "Captain's Log" commentary on the CICLOPS website. People writing to me have told me I should write a book. And so, I will. It'll be about Cassini, but the subtext is going to be about spirituality, and it's called "The Captain's Log." (Don't tell Kirk, though!)

**Q:** The best thing about being head of the Cassini Imaging Team is?

**A:** Being able to present our images to the public in an artistic way, and being as creative as funding will allow in doing that. We could do so much more if we had more funding, though.

**Q:** Finish this sentence: "The word my family, friends and co-workers would use to describe me are \_\_\_\_\_"

**A:** I know exactly what they would say because they're never shy about telling me! "Brainiac, driven, intense, works too hard."

**Q:** "If I could dispel one myth about space scientists it would be?"

**A:** That we're all brain, and no heart and soul. We're not Spock, you know! ✨

Proud To Serve Vancouver's Astronomical Community



# Vancouver Telescope Centre

1859 West 4th Avenue, Vancouver, BC, V6J 1M4, Canada

Phone: (604) 737 4303 Fax: (604) 738 5717

Web: [www.vancouvertelescope.com](http://www.vancouvertelescope.com)